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Title : RESULTS OF TESTS ON ATLAS MISSILE SKIN TEMPERATURE GAGES. MODEL 7

Corporate Author : GENERAL DYNAMICS SAN DIEGO CA CONVAIR DIV

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Abstract : During flight tests of the Atlas missiles, it will be necessary to measure and telemeter to ground receiving stations numerous surface temperatures at various locations on the missile skin. It has been proposed that temperature sensitive platinum resistance gages be attached to the missile surfaces to perform this function. Since these temperature gages will be exposed to aerodynamic heating and high velocity air flow, they must of necessity be strong and well-bonded to the missile surface. In order to investigate the adequacy of the proposed gage installations, a series of test has been conducted in which the gages have been subjected to an environment similar to that which they will encounter during actual missile flight.

Descriptors : *RESISTANCE THERMOMETERS, *SURFACE TO SURFACE MISSILES, STRENGTH (PHYSIOLOGY), TEST METHODS, MEASURING INSTRUMENTS, BONDING, PLATINUM, ENVIRONMENTAL TESTS, CALIBRATION, SURFACE TEMPERATURE, AERODYNAMIC HEATING, THERMAL STRESSES, TELEMETER SYSTEMS, FLIGHT TESTING, PERFORMANCE(ENGINEERING)

Subject Categories : SURFACE-LAUNCHED GUIDED MISSILES
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REPORT RT-318

DATE 20 December 1957

MODEL 7

TITLE

RESULTS OF TESTS

ON

ATLAS MISSILE SKIN TEMPERATURE GAGES,

Model 7.

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I. INTRODUCTION

During flight tests of the Atlas missiles, it will be necessary to measure and telemeter to ground receiving stations numerous surface temperatures at various locations on the missile skin. It has been proposed that temperature sensitive platinum resistance gages be attached to the missile surfaces to perform this function. Since these temperature gages will be exposed to aerodynamic heating and high velocity air flow, they must of necessity be strong and well-bonded to the missile surface. In order to investigate the adequacy of the proposed gage installations, a series of tests has been conducted at the Thermodynamics Laboratory in which the gages have been subjected to an environment similar to that which they will encounter during actual missile flight.

II. SUMMARY

From the tests which have been conducted, it appears that gage installations having no post-application temperature cure have insufficient strength to remain bonded to the missile skin when exposed to a relatively low velocity flow of heated air over the surface. However, curing of the gage installations at moderate temperatures (400-600°F) increased the bond strength to such a degree, the gages remained firmly attached to the skin sample after continuous exposure to a 1000°F air flow having a dynamic pressure of approximately 200 lb/sq. ft. for a period of three minutes. Temperatures indicated by the test gages were lower than the actual skin temperatures during transient heating conditions, but approached true skin temperature fairly closely when steady state heating conditions were achieved.

III. TEST EQUIPMENT & PROCEDURE

A number of .016 inch thick stainless steel panels having skin temperature gage installations typical of those proposed for use on the Atlas flight test missiles were supplied for testing by the Astronautics Data Transmission Group. The platinum resistance gages, Ref. CVAC Part No. 701259-5, are produced by Trans-Sonics, Inc., Lexington, Mass.; have a nominal room temp resistance of about 55 ohms; and provide a resistance change of about 0.1 ohms per °F over their working range of -300°F to 900°F. The gages are applied directly against the surface of the skin and are backed with a protective cloth covering impregnated with a silicone adhesive. Chromel-alumel thermocouple junctions were spotwelded onto the test panels as follows: T/C #1, attached to the back side of the panel, directly under the temperature gage; T/C's #2 and #3 attached to the panel upper surface, 1 inch ahead of and 1 inch to the side of the center of the gage, respectively. The panel was located immediately downstream of a two-dimensional convergent-divergent nozzle having an exit 3.05 inches wide and 0.725 inches high (Figure 1). The panel was mounted with its surface parallel to the lower lip of the nozzle, with the temperature gage approximately two inches downstream of the nozzle exit. Air at any temperature between ambient and 1000°F., at velocities from Mach 0 to 0.40 and M = 1.94, and dynamic pressures from 0 to 5600 lbs/sq. ft. was available from the nozzle during the tests. A shielded chromel-alumel thermocouple junction, located downstream of the gage just above the surface of the test panel, was used to determine the temperature of the heated air flowing over the test specimen.

The platinum resistance element of the temperature gage was connected as one leg of a Wheatstone bridge having an output sensitivity, $\Delta E/\Delta R_G$, of approximately 1.1 MV/ohm. The bridge was calibrated periodically by replacing the resistance gage leg of the bridge with a series of different, accurately known resistances and noting the corresponding bridge output. The outputs of the thermocouples and transducer bridge were continuously recorded during each test with an Offner direct writing oscillograph recorder. Conversion of the thermocouple voltage outputs to the equivalent temperatures were made with the standard temperature - EMF tables for Chromel-alumel thermocouples. Standard temperature-resistance characteristics for platinum wire (See Fig. 2) were used to convert the temperature gage resistance changes to the corresponding temperature changes.

A total of seven gage specimens were tested under varying temperature and dynamic pressure conditions. Individual tests varied from 10 to 180 seconds duration. Nearly all specimens were subjected to a number of consecutive tests of increasing duration and severity of test conditions before failure occurred. A "step" temperature input was applied to the test specimens by means of a large two-way valve located upstream of the air flow nozzle. The pressure and temperature of the air stream were adjusted to the desired test conditions with the valve in a by-pass position. Following this, the valve was rapidly rotated to divert the hot air from the by-pass outlet to the flow nozzle and provide essentially a "step" heat input to the temperature gage.

IV. RESULTS AND DISCUSSION

Early in the test program, it became obvious that the proposed uncured gage installations had insufficient mechanical strength to withstand exposure to air temperatures in the range of 200-300°F (see Table I). All four of the uncured gage specimens that were tested peeled loose from the test panels after less than 30 seconds exposure to air temperatures below 400°F and at free stream dynamic pressures only about one-half as large as are anticipated during actual missile flights. Figure 3 shows typical failures of two of the uncured gage specimens. The gage on the top panel, specimen #1, came loose from the surface and was completely destroyed after only 5.5 seconds exposure to a 200°F, $q = 550$ lbs/sq. ft. air flow. Note that even the covering over the gage leads failed under these conditions. Gage specimen #2 on the lower panel failed after 23.5 seconds exposure to a lower velocity ($q = 59$ lbs/sq. ft.), but considerably hotter (350°F) air stream. Only the material actually covering the gage itself loosened under these conditions, while the remainder of the cloth covering remained relatively intact. The white material near the downstream end of the gage leads is Sauereisen cement, applied to protect the area where the leads passed through holes in the test specimen from the surface to the underside. An additional series of tests was conducted with a fifth uncured specimen while flowing unheated air over the surface at dynamic pressures up to 5000 lb/sq. ft. No damage or loosening of the gage was observed even after several minutes exposure to the high velocity flow, thus indicating the rapid failure of the other gages must have resulted primarily from high temperature deterioration of the elements rather than from erosive action from the air stream.

Following these initial unsuccessful tests, three additional test samples having two different post cure treatments were prepared and tested. The post cures consisted either of heating the panels and installed gages at a temperature of 450°F for 30 minutes or 650°F for 15 minutes. Gage #6 (see Fig. 4) having the 650°F - 15 minute cure was subjected to a series of tests with increasingly higher air temperatures, finally being exposed to an air temperature of 870°F and dynamic pressure of 214 lbs/sq. ft. for a period of 180 seconds without failure. Of the two specimens cured at 450°F for 30 - 40 minutes, one sample (No. 5 in Fig. 4) satisfactorily withstood a 1000°F., q = 213 lbs/sq. ft. air flow for 180 seconds with no failure of the gage and only slight loosening of the leads. The other sample (No. 7 in Fig. 4) was subjected to two successive runs of 120 and 180 seconds at gas temperatures of 700 and 1100°F., respectively, and finally to a gas temperature of 1300°F before loosening of the gage and failure occurred after 39 seconds exposure.

In all of the tests described above, the air flow was directed parallel to the gage leads. However, since some gage locations on the flight missiles may require routing the gage leads circumferentially around the outer surface, a limited number of tests were conducted with the air flowing laterally across the gage leads. Under these cross-flow conditions, no failures of the temperature cured gage installations were encountered at gas temperatures below 700°F and dynamic pressures to 200 lbs/sq. ft. However, at a gas temperature of 850°F, the leads loosened and blew away after only 10 seconds exposure to the air flow.

Temperature-time histories for the free stream, gage and two skin temperatures during several typical test runs are shown in Figures 5 - 10. In Figure 5, during run No. 1, unintentional variation of the free stream temperature provided a good indication of the response characteristics of the gage installation. Figures 6 - 10 indicate the gage response when exposed to step temperature inputs of various magnitudes. In general, response of the temperature gages when subjected to a relatively rapid temperature increase was good, although the temperature indicated by the gage definitely lagged the temperature of the skin which was exposed to the free stream by varying amounts of time. It was also observed, as would be expected, that during transient heating conditions, the temperature of the skin directly beneath the transducer remained considerably cooler than other skin areas because of the good insulating characteristics of the relatively thick gage installations.

IV. CONCLUSIONS:

though only a limited number of temperature gages were tested, and these at relatively low free stream temperatures and pressures (compared to conditions which will be encountered at high supersonic Mach numbers), enough information has been obtained to arrive at the following general conclusions:

1. The gage installations in the uncured condition have insufficient bonding strength to remain attached to the missile skin when exposed to a low temperature, low velocity air flow.

2. Temperature curing of the gage installations after application on the missile skin will provide sufficient additional strength to allow the gages to satisfactorily withstand a high temperature (1000°F) and relatively high velocity air flow. However, it is possible that temperature curing of the gage installations may adversely affect the physical characteristics of the transducer as evidenced by the fact that two of the three temperature-cured gage specimens which were tested exhibited erratic and unreliable resistance characteristics following their cure. A more complete investigation of possible detrimental effects on the gages resulting from temperature curing should certainly be made before large numbers of gages are installed on the missile.

3. Due to the large thermal capacity and low conductivity of the transducer covering, transient response of the gages to changing skin temperatures will not be as rapid or as accurate as would be obtained with thermocouples attached directly to the missile skin. However, use of the resistance gages has the advantage that the transducer element need only touch the missile skin, and does not, as would be the case if thermocouples were used, require spotwelding or other fastening techniques which might disturb the structural integrity of the thin missile tank walls.

4. The relatively thick gage leads and their covering, particularly those that must be routed circumferentially around the missile body cross-wise to the free stream air flow, may loosen and fail more readily than the gages themselves.

5. Output sensitivity of the transducer is high when installed

in a suitable bridge. An output of approximately 0.25 mV/°F was readily obtained with the simple bridge used in these tests. This compares to an output of about .03 mV/°F from an iron-constantan thermocouple, or a sensitivity about 8 times as great.

6. At the time these tests were conducted, at least as far as the writer could determine, there was an apparent lack of reliable temperature-resistance calibration data for these platinum resistance gages. If this situation has not been corrected, certainly every effort should be made to insure that sufficient data is available to make accurate resistance to temperature conversions.

SUMMARY OF TEST CO

TAB

All temps. are fir

RUN	DURATION (sec.)	SPECIMEN	CURE	Tair(°F)	T1(°F)
1	76	#1	None	200	175
2	25	"	"	185	151
3	54	"	"	190	167
4	33.5	"	"	145	112
5	5.5	"	"	200	110
6	31	#2	"	135	105
7	36	"	"	255	203
8	23.5	"	"	349	215
9-19	60-90	#3	"	70	70
20	70	"	"	-	-
21	35	"	"	-	-
22	30	"	"	-	-
23	35	"	"	-	-
24	30	"	"	-	-
25	32	"	"	-	-
26	15	"	"	-	-
27	180	#4	"	175	-
28	180	"	"	350	289
29	180	"	"	200	165
30	< 5	"	"	355	-
31	180	#6	15 min.@ 650°F	385	315
32	180	"	"	377	325
33	180	"	"	515	340
34	180	"	"	785	515
35	180	"	"	870	545
36	180	#5	40 min.@ 450°F	455	315
37	180	"	"	735	540
38	180	"	"	1010	745
39	10	#10	15 min. @ 600°F	850	-
40	180	"	"	705	-
41	121	#7	30 min.@ 450°F	733	446
42	180	"	"	1080	740
43	39	"	"	1345	1005

A

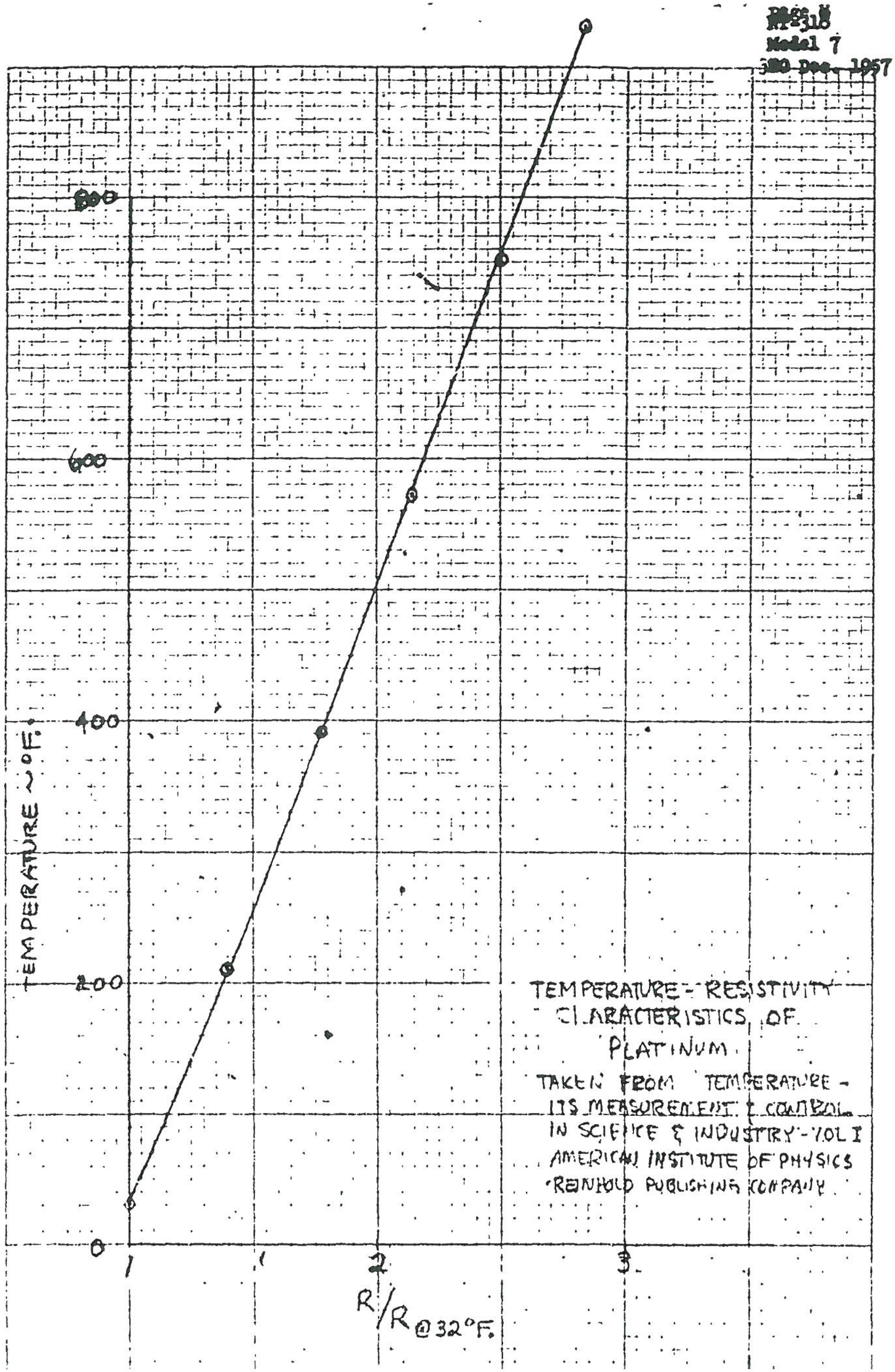
TEST CONDITIONS AND RESULTS

TABLE I

are final temps. @ end of run.

T_1(°F)	T_2(°F)	T_{gage} (°F)	q(lbs/sq.ft.)	COMMENTS
175	169	168	142	Gage OK.
151	153	159	-	Gage still in good condition.
167	160	170	125	" " " ", "
112	121	123	625	Lead wires loosened slightly. Gage OK.
110	197	144	550	Gage failed.
105	129	127	38	Gage and leads OK.
203	215	232	59	Gage still OK.
215	154	248	59	Gage failed.
70	70	70	38-5000	Cold flow tests. Gage and leads OK @ all test conditions.
-	88	-	43)	
-	115	-	43)	T/C #2 only used during these
-	167	-	43)	tests. Transducer not functioning
-	163	-	48)	properly. Gage OK 20-23.
-	250	-	48	Covering becoming soft and tacky and slightly loose.
-	285	-	48	Covering very soft and loose.
-	320	-	54	Gage and leads failed.
-	-	-	60	T/C's not operating. Gage and leads OK.
289	324	298	66.	Gage OK-Soft and tacky, however.
165	180	182	108	Gage OK.
-	-	-	143	Gage failed at start of run.
315	345	Erratic	143	Gage and leads OK - erratic operation of gage, however.
325	332	-	> 200	Gage still OK - no signs of loosening.
340	410	-	142	Gage OK-not operating electrically, however.
515	605	-	171	" " " "
545	700	-	214	Gage still OK - Discontinued tests on specimens.
315	420	-	171	Gage OK-Doesn't work electrically, however.
540	630	-	213	Gage OK-Somewhat soft.
745	840	-	213	Leads loosened @ about 30 sec. Gage remained tight, however.
-	-	-	100	Cross flow over gage leads. Loosened and failed @ 10 sec. No gage or T/C's on specimen.
-	-	-	202	Gage leads OK-no loosening.
446	-	532	210	Gage & leads OK-No loosening. T/C #2 inoperative.
740	-	785	170	Gage & leads still OK.

FIG. 1 Convergent - Divergent Nozzle



TEMPERATURE - RESISTIVITY CHARACTERISTICS OF PLATINUM.

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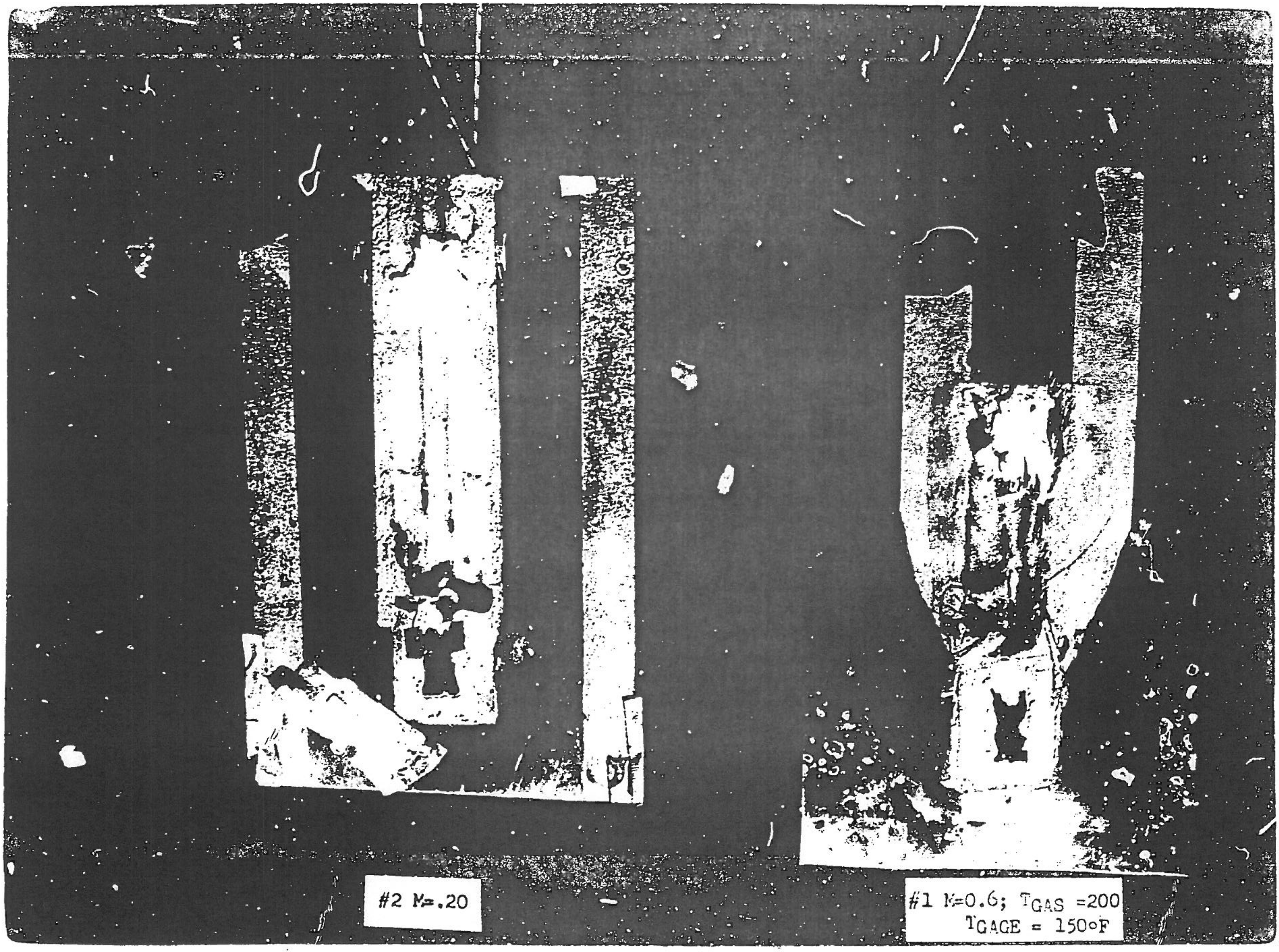
#2 M=.20
#1 M=0.6; T_{GAS} =200
T_{GAGE} = 150°F

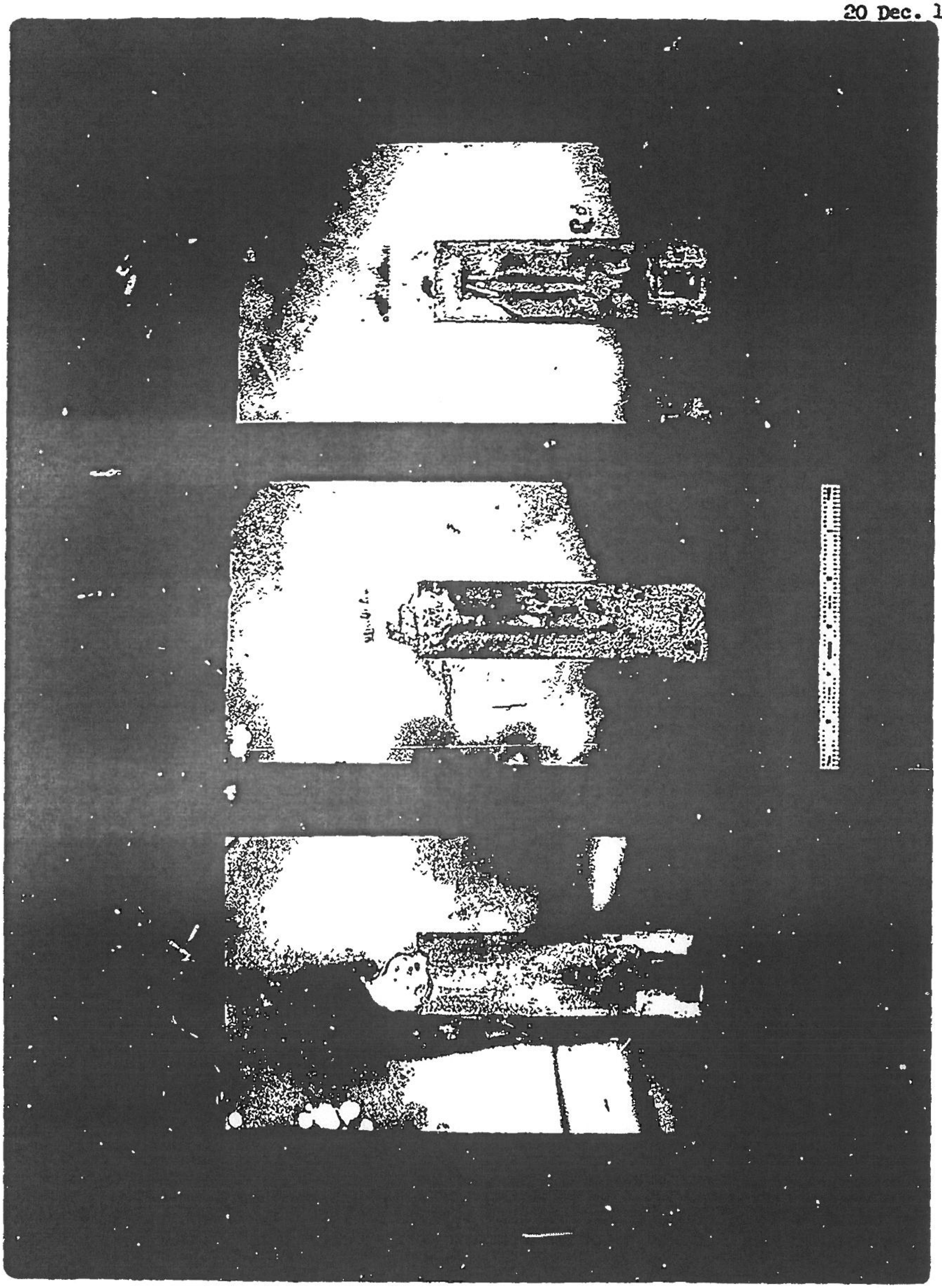

FIG. 4 Typical Cured Gage Specimens

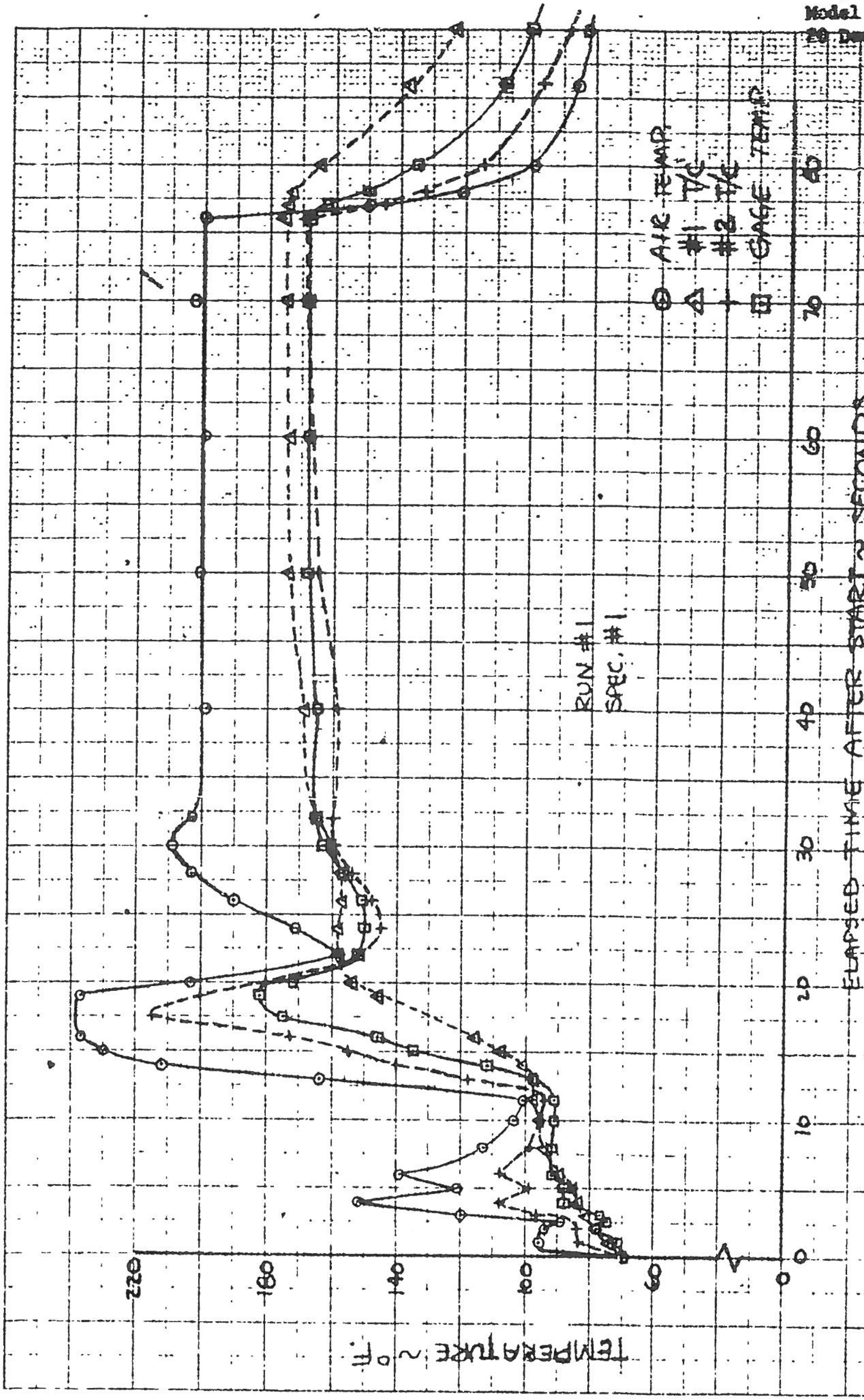

FIG. 5 . TEMPERATURE - TIME HISTORY

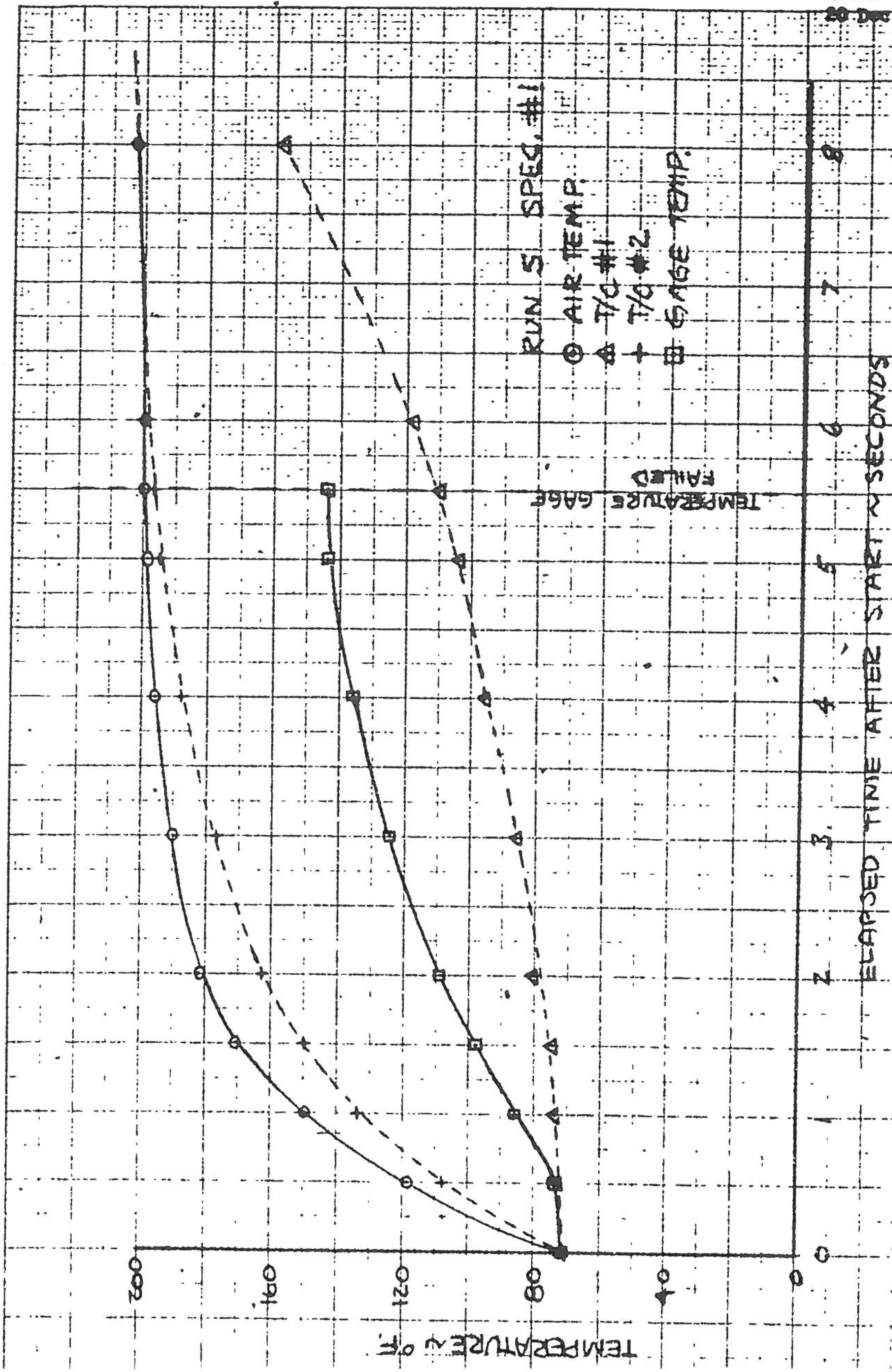

FIG. 6 TEMPERATURE - TIME HISTORY

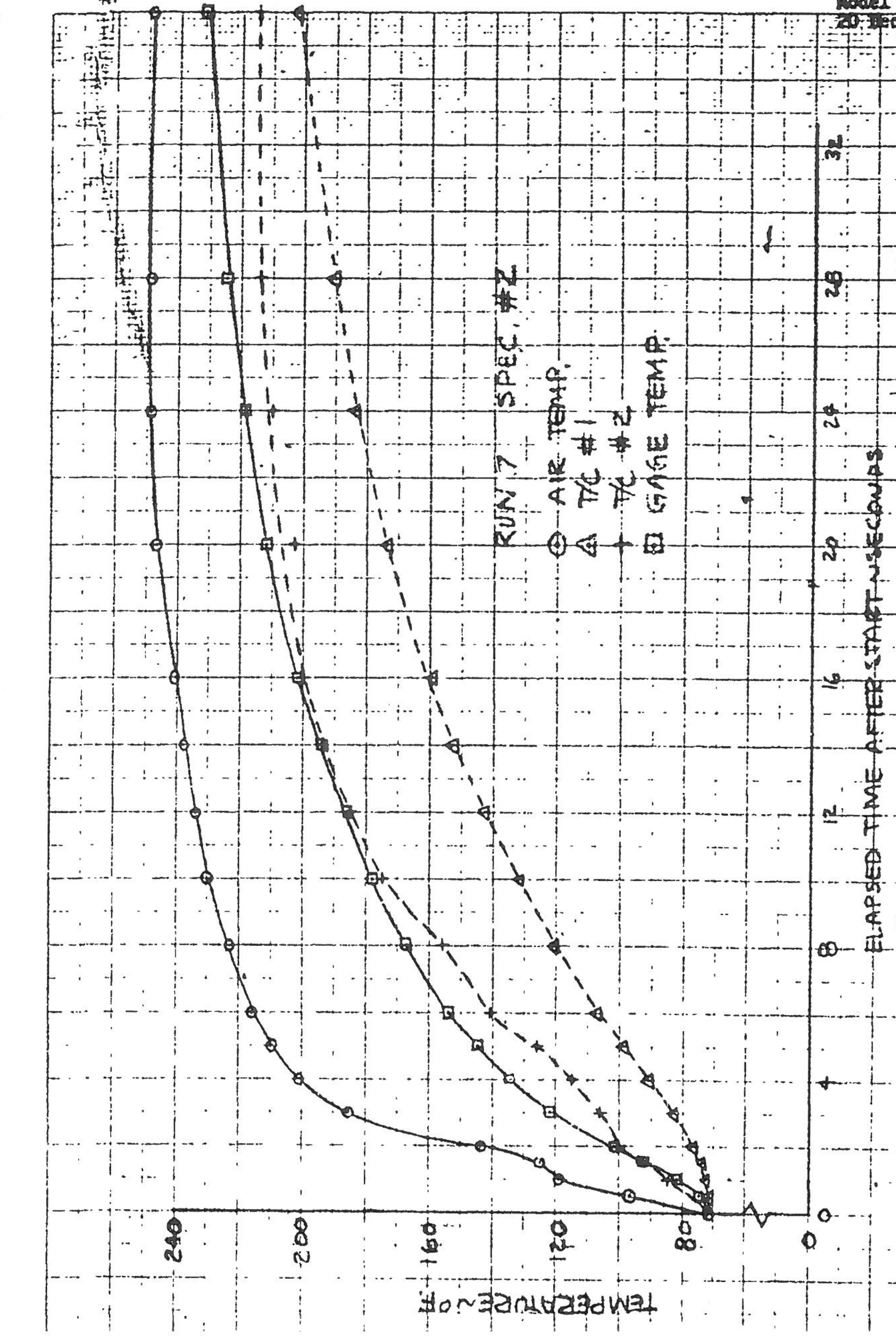

FIG. 7 TEMPERATURE - TIME HISTORY

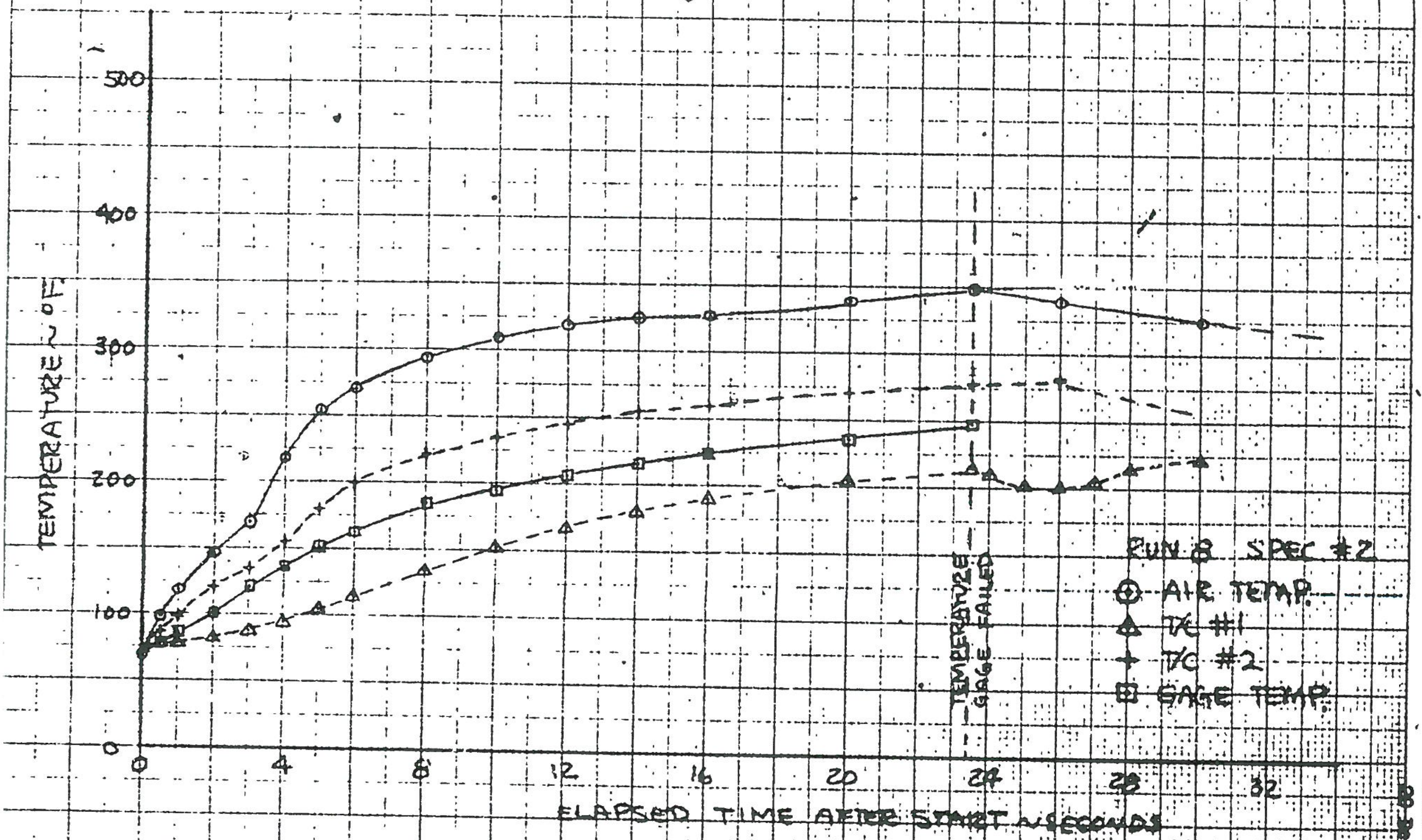

FIG.8 TEMPERATURE - TIME HISTORY

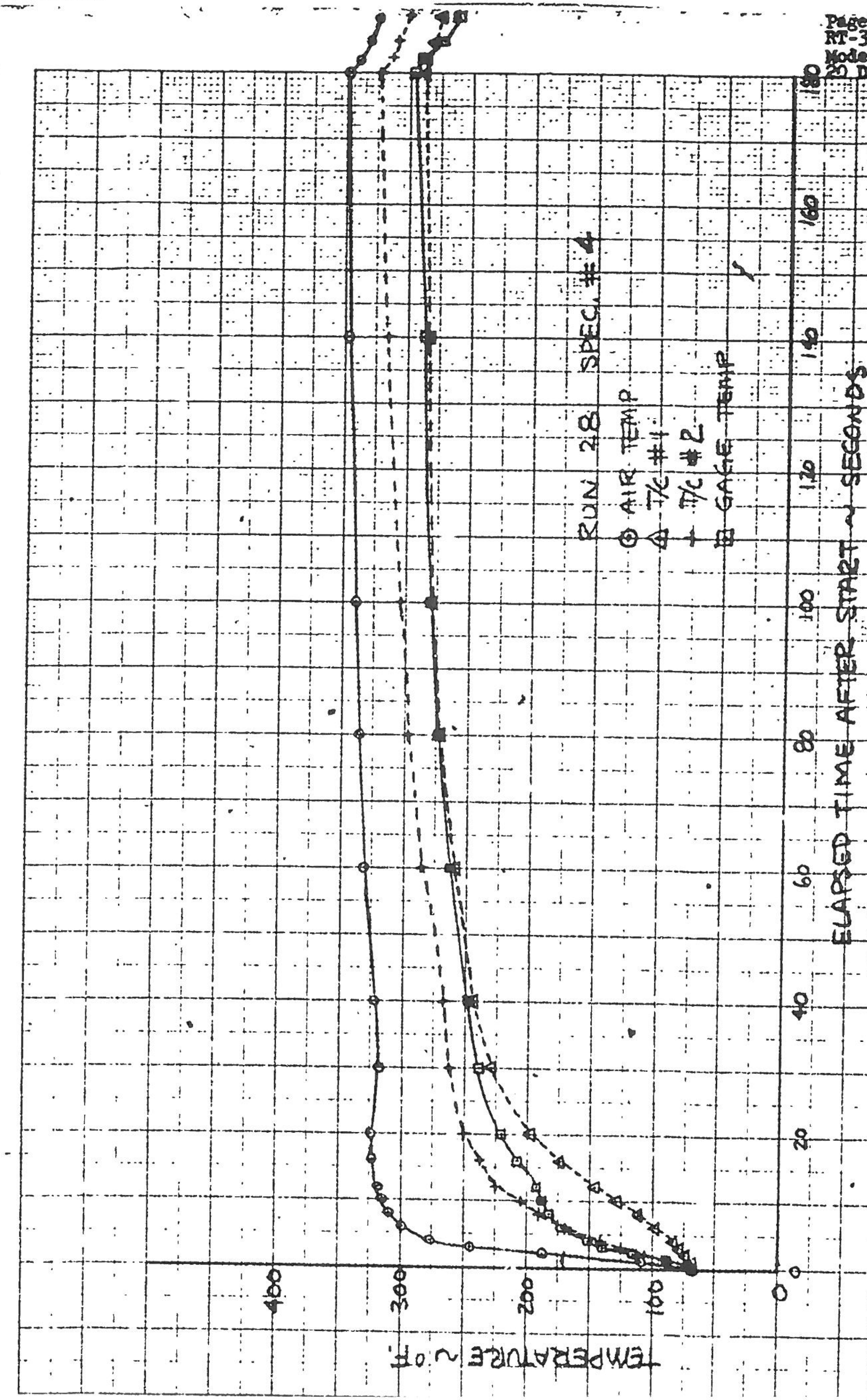

FIG. 9 TEMPERATURE - TIME HISTORY

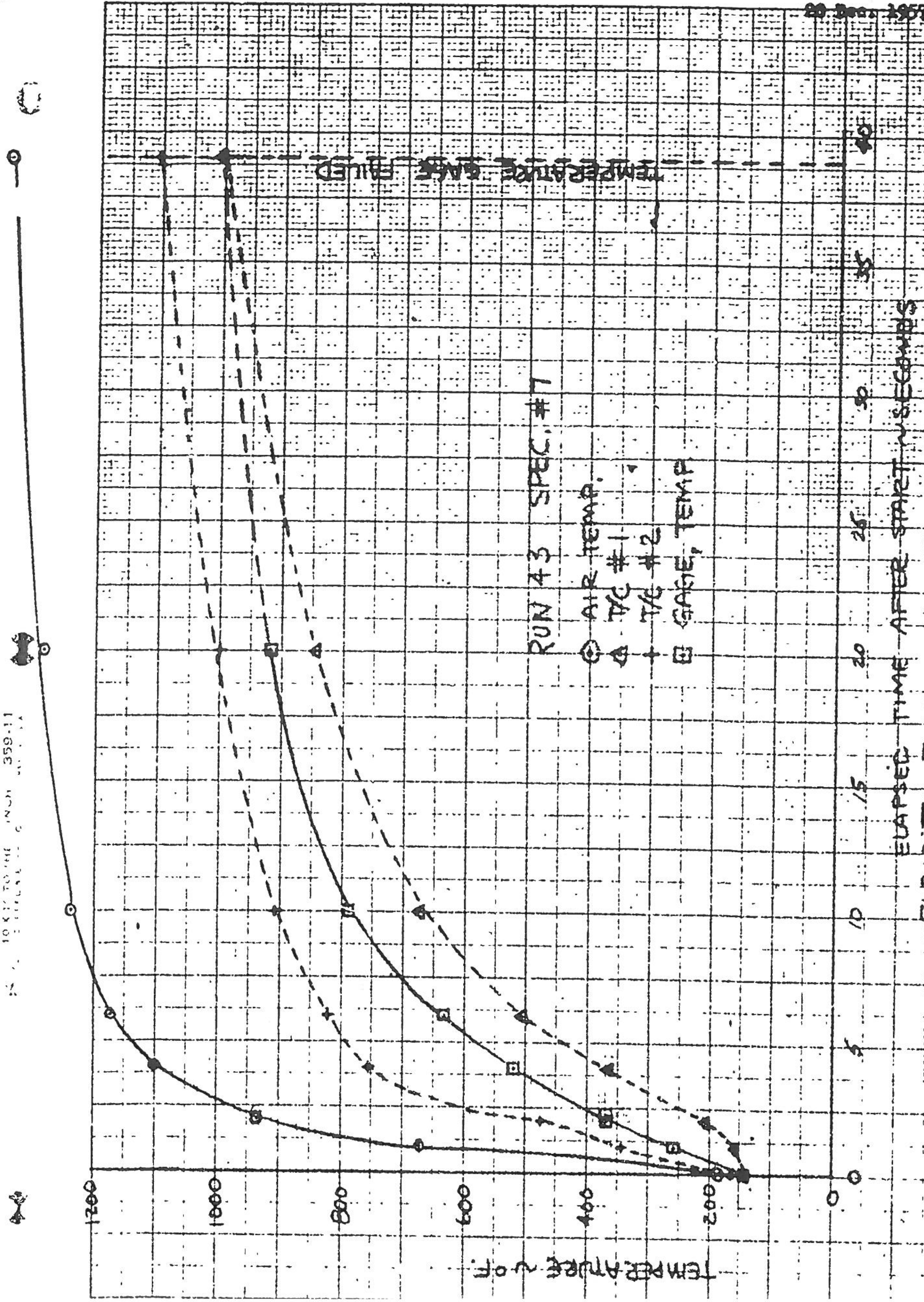

FIG 10 TEMPERATURE-TIME HISTORY

Title : 1/30 SCALE XSM-65A MISSILE BASE RECIRCULATION MODEL TESTS,

Corporate Author : GENERAL DYNAMICS SAN DIEGO CA CONVAIR DIV

Personal Author(s) : Hendershot, K. C. ; Leo, P. P.

Report Date : 31 JAN 1958

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Abstract : As a result of the flight test observations, a scale model test program was initiated at the Thermodynamics Laboratories to determine whether recirculation of the turbine exhaust gases could occur under simulated flight conditions and to arrive at a suitable 'fix' if a problem was found to exist. One-thirtieth scale model tests of the Atlas missile base and turbine exhaust duct configuration have indicated a bent duct directed into the free stream should prevent recirculation and burning of hot turbine exhaust gases during low altitude, subsonic flight. A straight exhaust duct, extended approximately eight feet downstream of the base of the missile, would probably also provide reasonable assurance of no turbine exhaust gas recirculation. (Author)

Descriptors : *GAS TURBINES), (*SURFACE TO SURFACE MISSILES, (*EXHAUST GASES, GAS FLOW), MODEL TESTS, GAS GENERATING SYSTEMS, DUCTS, BASE FLOW, FLIGHT TESTING, SIMULATION, SCALE, TEST METHODS, BURNING RATE, LOW ALTITUDE, TURBOPUMPS, TURBOJET EXHAUST NOZZLES.

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DETERMINATION OF PROPELLANT RECIRCULATION ON A 1/30 SCALE ATLAS MODEL USING RARE GAS TRACER TECHNIQUES,

Authors: John T. Neu; A. S. Frisch; GENERAL DYNAMICS/ASTRONAUTICS SAN DIEGO CA

Abstract: A 1/30 scale model of the Atlas missile was tested in the NACA Wind Tunnel to study the characteristics of recirculation and heating by fuel-rich rocket and turbine exhaust gases burning in the vicinity of the blunt aft section of the missile. A method to determine the relative contributions from these gaseous sources was devised based on the sampling and analysis of tracer gases added to the propellants. One percent helium and one percent neon, respectively, were added to the rocket and turbine gases. Naturally occurring air contains about one percent argon. Samples from the base region were withdrawn through a set of tubes during the rocket firingg. The proportions of helium, neon and argon were determined with a mass spectrometer, and from these proportions by weight of rocket propellant, turbine exhaust, and air at the point of sampling were calculated. Thus, the presence and source of a mixture with potential heating value in the base region was determined. (Author)

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Propulsion, Engines and Missiles » Liquid Propellant Rocket Engines

A PRELIMINARY ANALYSIS OF ROCKET EXHAUST JET EFFECTS ON MISSILE SKIN AND BASE PRESSURES AT MACH 0.6 AND 1.5 - NACA LEWIS FLIGHT PROPULSION LABORATORY TEST 2093,

Authors: G. E. Powell; GENERAL DYNAMICS/ASTRONAUTICS SAN DIEGO CA

Abstract: A wind tunnel test of a one-thirtieth scale 'B' series Atlas missile with operating rocket engines was run at the NACA Lewis 8-by-6 foot supersonic wind tunnel. The primary test objective was to determine the amount of rocket and gas turbine exhaust recirculation into the missile base region; a secondary objective was to determine the effect of operating rockets on missile skin and base pressure. Only the pressure data are considered in this report. (Author)

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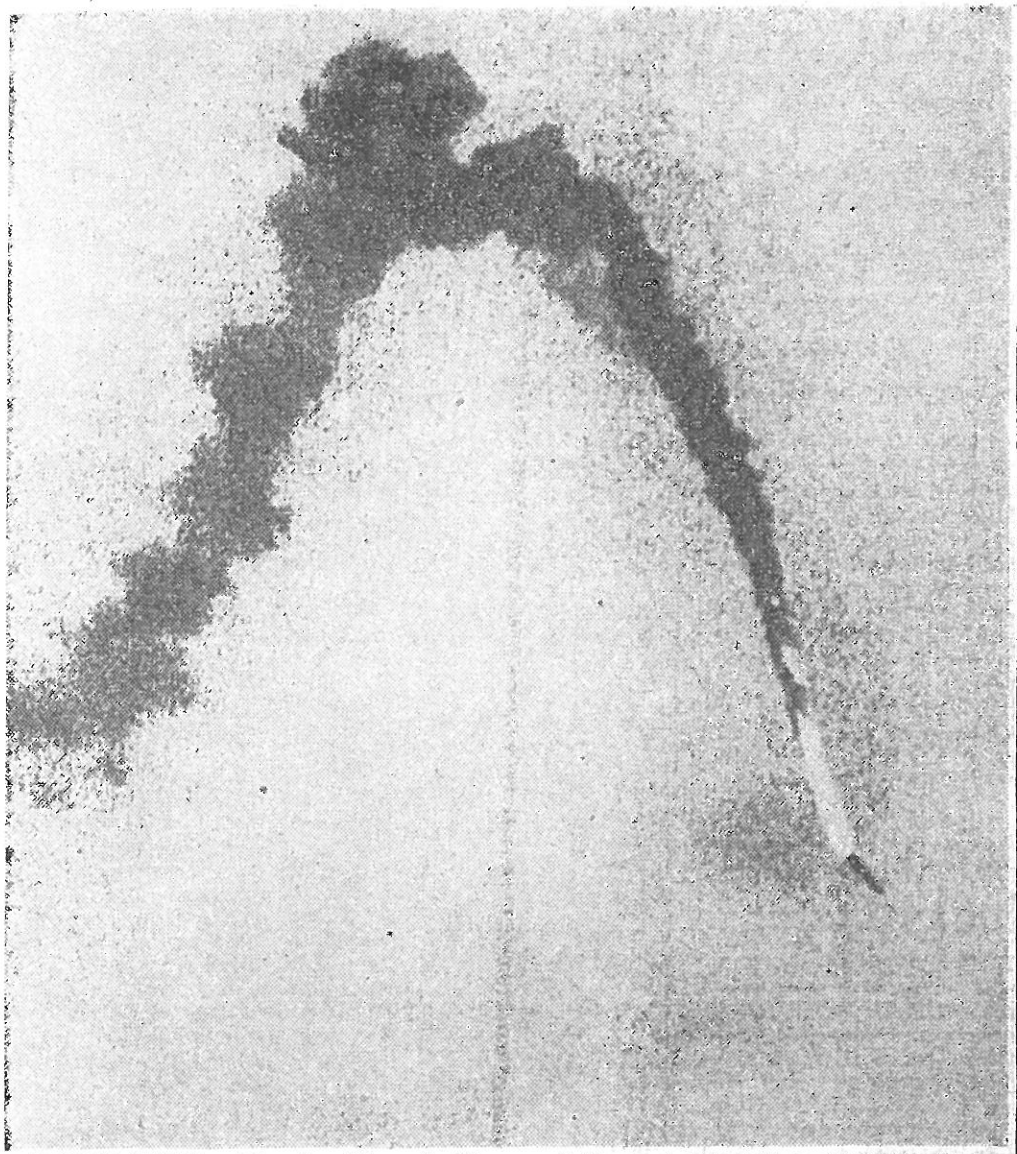

SMOKE LEFT — The San Diego-built Atlas missile leaves a path of smoke and flame behind it as it falls after an explosion during yesterday's test.

Rocket 'Veers,' Explodes in Mile Flight

'Failure' Reports Wrong, Says Pentagon Officer

By FRANK MACOMBER
COPLEY PRESS Bureau

WASHINGTON — Yesterday's test launching of Convair's first Atlas missile at Cape Canaveral, Fla., today was described in the Pentagon as "a successful flight."

The giant San Diego-built missile wobbled and exploded a mile or two above the launching pad, with the pieces falling into the Atlantic Ocean, press services reported from Florida.

Wrong in Interpreting

They quoted eyewitness accounts by civilians who watched from vantage points outside the boundaries of the guarded missile base.

"All the eyewitnesses were wrong in interpreting the flight as a failure," an Air Force officer declared in the Pentagon today. He would not permit his name to be used.

"It was a very successful flight," he said. "We obtained a great deal of important information. We have already found out what went wrong and it is something we can correct for the flight of the second Atlas."

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EVENING TRIBUNE

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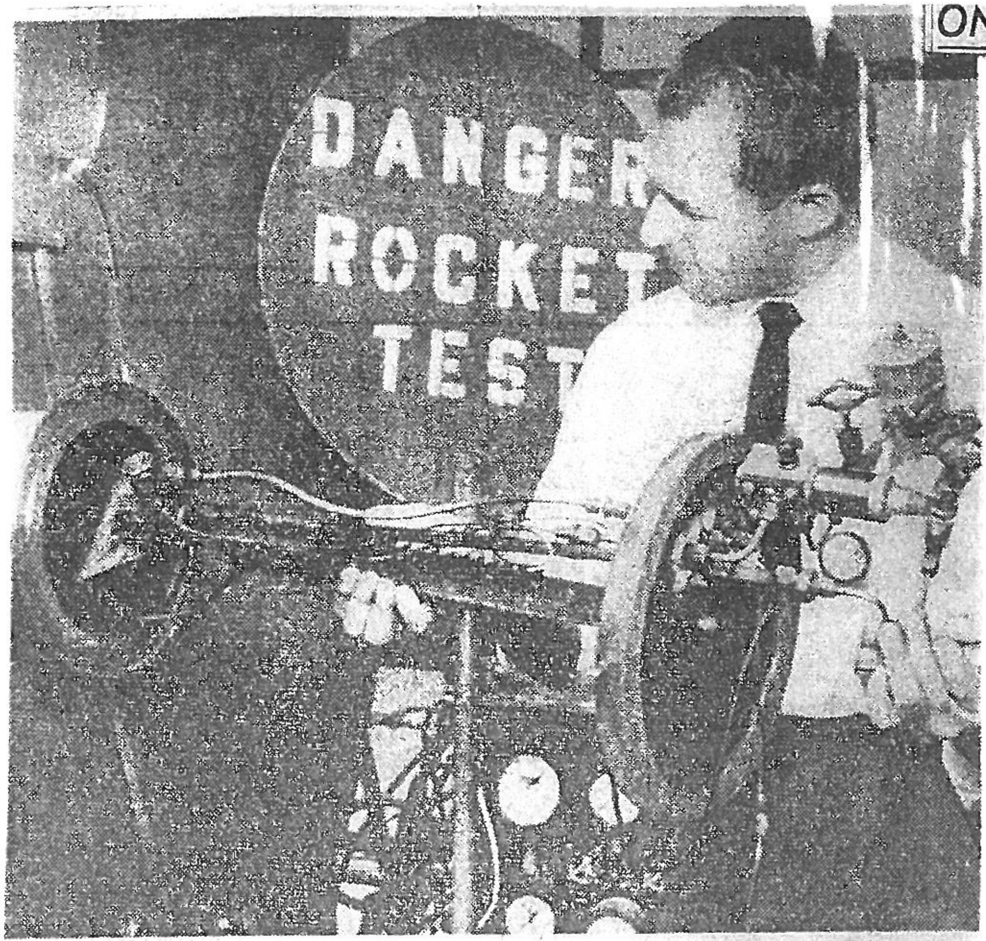
CALIFORNIA, WEDNESDAY, JUNE 12, 1957 ★ 10 CENTS

ONE-INCH NOZZLES

Midget Rockets Aid Atlas Study



Kenneth C. Hendershot, senior thermodynamics engineer at Convair, inserts a miniature rocket assembly into a high-altitude tank for rocket exhaust behavior tests at Convair's thermodynamics laboratory here.

Convair engineers are using midget rocket motors mounted in vacuum chambers to study how the Atlas intercontinental ballistic missile will behave in space.

The test rockets are used in Convair-Astronautics thermodynamics laboratory here. Their nozzles narrow to one inch in diameter.

In the laboratory, altitudes of up to 40 miles are duplicated in a cylindrical, steel vacuum tank six feet in diameter and 10 feet long.

One of the miniature rockets is fired for a second and a half, using a mixture of oxygen and gasoline.

Engineers watch the model through a one-inch plate glass window. The yellow-white rocket flame fans out as atmospheric pressure is reduced. By placing material specimens near the jet, engineers can determine how the flame might affect such surfaces. The rocket flame is 5,000 degrees Fahrenheit.

New test facilities include a vacuum tank where conditions 50 miles high can be simulated in a hypersonic wind tunnel.

The tunnel will enable engineers to study the reaction of rocket exhausts to certain conditions of velocity and altitude at the same time.

High-pressure helium is pushed through a nozzle and passed through a part of the tunnel containing the test rockets. Speeds up to seven times faster than that of sound are obtained.

WEDNESDAY, APRIL 9, 1958

Marston Students to Enter Work In Greater SD Science Fair

The science exhibits of six Marston Junior High School boys will be among the entries when the Greater San Diego Science Fair opens Friday at the Conference Building in Balboa Park.

Jesse Ketcham and Duane Williams will enter a Class C free-flight plane which they designed and built. The plane has a nine foot wing span, and its fuselage is about seven feet long.

Jesse and Duane have worked separately on their hobby for several years but began working together a year and a half ago. Both boys' fathers are interested in aircraft.

Duane's father, Henry L. Willaims, is an assistant foreman at Convair and Jesse's father, Earle Ketcham, is a field representative for Grumman Aircraft Corp.

Another entry will be "The Life Cycle of the Cecropia Moth" by Ken Tigard. Ken became interested in the Cecropia when one lit on his shoulder as he bicycled along Clairemont Dr. He studied all the information he could find and discovered that the Cecropia's natice habitat is the East Coast and northern Maine; hence it is very unusu-

E. Tigard, is a designer for the Astronautics Division of Convair, intends to study law, bu tis also interested in experimental farming.

The third proejct is the entry of Rick Tyler, Bob Kennedy, and Bill Green. The boys, who describe their interest in rockets as "predating Sputnik," designed and built a liquid propellant rocket. The rocket is between six and seven feet long, tip to tail.

The boys started working with solid propellant rockets and still are interested in them.

After they designed their present rocket they got advice and help in getting parts from Kenneth Hendershot, rocket technician at Convair.

Some of the work has been done in the school metal shop as well as at home. According to its builders, the rocket will be fired after further engine tests on the ground.

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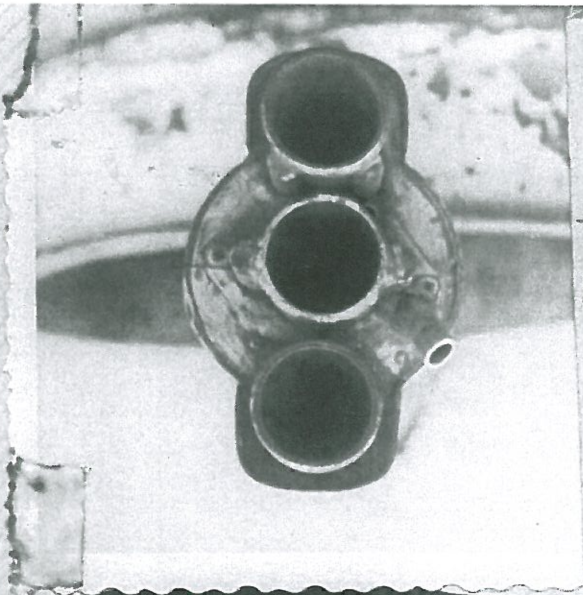

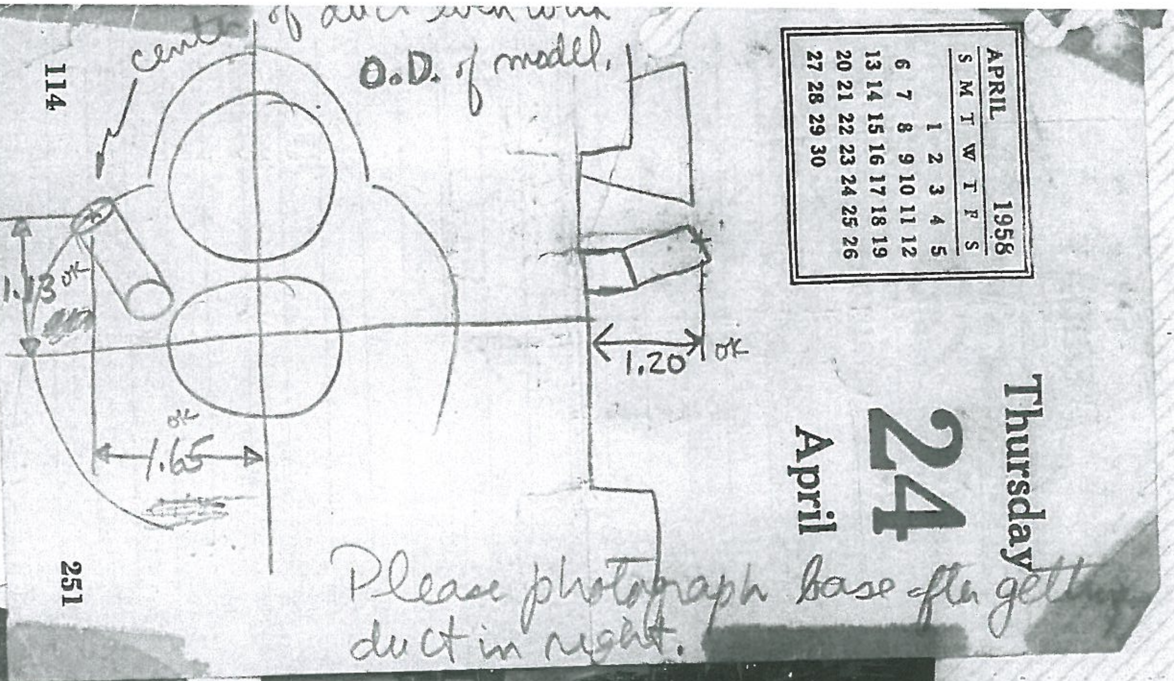

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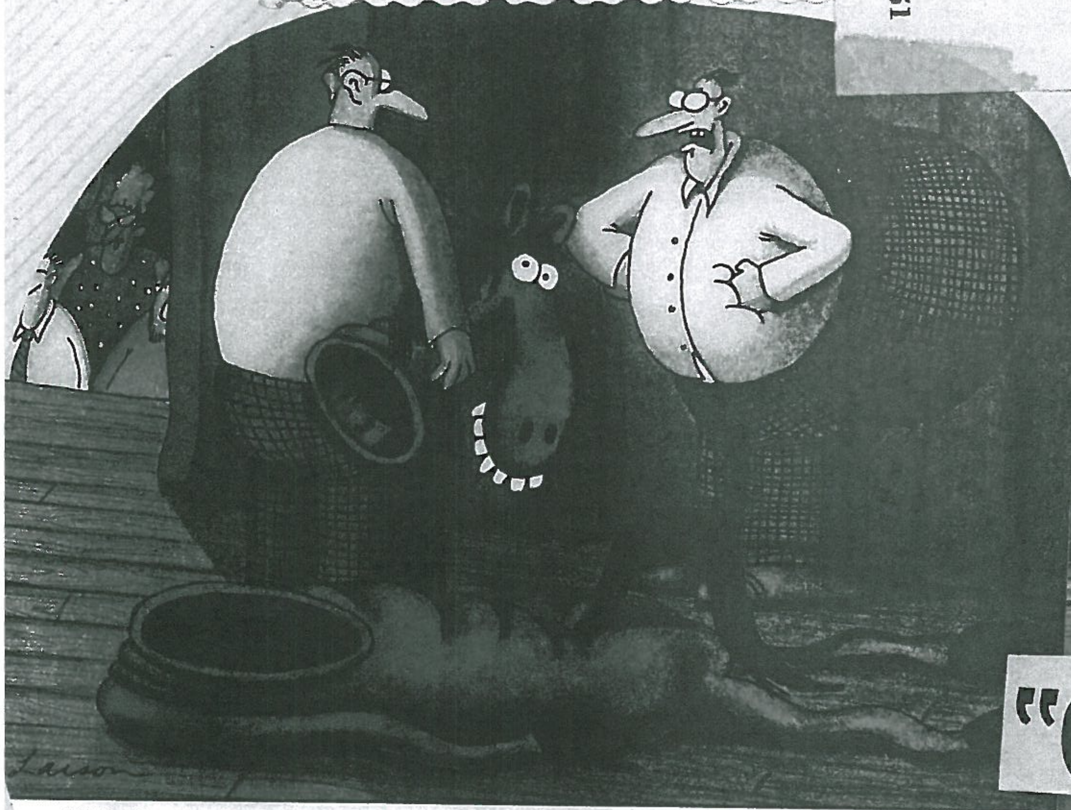

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BUSINESS

Hendershot, Herron, Buchanan Receive Calspan Promotions

Kenneth C. Hendershot, one of four facility directors for Calspan at Arnold Center, has been named general manager of Calspan operations at the NASA/Ames Research Center, Moffett Field, Calif.

He will be replaced at AEDC by R. Dean Herron, who will advance from deputy director to director of the systems operation facility. In a related move, W.T. Buchanan will become manager of the tunnel operations branch, supervising a work force of 112.

Hendershot will assume leadership of the Calspan/Ames effort at the beginning of a second five-year contract worth $52.6 million. He will head a work force of approximately 125 engineers and technicians who perform aerospace flight dynamics testing and operate and maintain several transonic and supersonic wind tunnels, shock tubes and ranges for hypersonic testing. The appointment was made by King D. Bird, Calspan senior vice president and general manager of the Service Contracts Division headquartered in Tullahoma.

Hendershot came to AEDC in 1980 from the company's corporate headquarters in Buffalo, N.Y., when Calspan was awarded the operating contract for aerospace flight dynamics testing at the center. He has been director of the Von Karman gas dynamics facility until the company's recent reorganization, when he was named to head the systems operation facility.

Before joining AEDC he headed the transportation research department and served as principal research engineer in Calspan's Aerodynamic Research Department in Buffalo. He also worked for General Electric's corporate research and development center in Buffalo as manager of fluid mechanics programs. He holds bachelor's and master's degrees in aeronautical engineering from the University of Michigan and is a registered mechanical engineer in California.

KENNETH H. HENDERSHOT

Dean Herron has been an engineering manager at AEDC since 1959, beginning as a project and research engineer in the propulsion wind tunnel facility. Until the company's reorganization, Herron was manager of PWT's test engineering and operations branch. He holds a bachelor's degree in aeronautical engineering from Georgia Tech, a master's in mechanical engineering from UT-Knoxville, and has completed 30 hours of postgraduate work at UTSI.

W.T. (Buck) Buchanan began at AEDC in 1962 as a mechanical design engineer, later became a test installation engineer, and was made a section supervisor in 1977. He earned a bachelor's degree in mechanical engineering from UT-Knoxville and a master's in the same discipline from UTSI. He is a registered professional engineer in Tennessee.

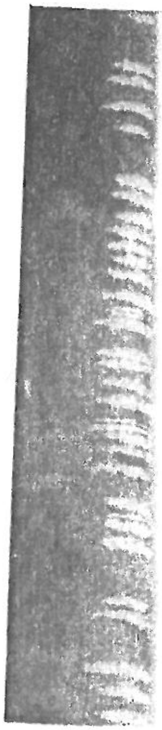
Child-Care Payments Can Get Tax Credit

Human Services Commissioner Nancy-Ann E. Min has reminded parents who pay for child care outside their home that a tax credit may be available to them.

"Parents should save their child care expense receipts and make use of this important tax advantage," Ms. Min said.

Parents can take up to a $1,440 credit on their income taxes for child care expenses. All taxpayers incurring such expenses are eligible for the credit regardless of the size or gross income of the family and whether or not they itemize, the commissioner said. However, the tax credit will benefit lower income families with at least two children the most.

Parents with adjusted gross income of $10,000 may take a 30 percent tax credit up to a maximum of $2,400 for one dependent and $4,800 for two or more dependents. At 30 percent, that's equal to a $1,400 credit. The rate of credit reduces by one percent point for each additional $2,000 or fraction of $2,000 of income above $10,000. The rate stops dropping at 20 percent for persons with incomes over $28,000.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aedc today

Monday | For the Employees of AEDC | January 25, 1988

Cafeteria Menu

Soup--Beef Rice
Salads--Tuna Salad, Jello with Fruit, Cole Slaw, Tossed Salad
Entrees--Turkey and Dressing, Swiss Steak
Vegetables--Whipped Potatoes, Baked Apples, Green Beans, Carrots
Desserts--Peach Cobbler, Chocolate Cake, Carrot Cake

Tomorrow's Entrees

Fried Chicken, Tuna Casserole

Today's Weather

Cloudy and cold with occasional snow flurries; high in the 30s, low around 10°.

Today's Events

Red Cross Bloodmobile: 8:00 a.m.-5:00 p.m. in the ETF Office Building. For details, call Ann Hodge at ext. 5385.

Intramural Basketball Games: 5:30 p.m. at the C.D. Stamps Community Center. For team schedules, call Recreation Services at ext. 6084.

Hendershot To Manage $52.6 Million Contract

Ken Hendershot has been named Calspan General Manager for the company's operations at NASA/Ames Research Center at Moffett Field, Calif. NASA has just awarded Calspan a second 5-year contract there with NASA, worth $52.6 million. As General Manager, Hendershot will head a workforce of 125 engineers and technicians who perform aerospace flight dynamic testing and operate and maintain several transonic and supersonic wind tunnels, shock tubes and ranges for hypersonic testing. Replacing Hendershot as director of the Systems Operations Facility is Dean Herron. W.T. Buchanan will replace Dean Herron as Manager of the Tunnel Operations Branch. The promotions are effective as of Feb. 1.

Bradley In Top 99.5%

Dale Bradley, general engineer in the AEDC Corporate Planning Office, was awarded the Air Force Meritorious Civilian Service Medal Friday night. The sterling silver medal and citation is one of the highest awards that can be presented to a civilian member of the Air Force, and is held by only half of a percent of the civilian employees of Systems Command. The award was presented by Joy Bishop, director of civilian personnel of Air Force Systems Command on behalf of Gen. Bernard Randolph. It is given to civilian employees who have demonstrated service so outstanding that recognition by a major commander or the Air Force Chief of Staff is warranted. Six other AEDCers received civilian awards Friday night. They will be featured in tomorrow's *aedc today.*

Thought For A Monday

FINAGLE'S RULES, No. 9: In any collection of data, the figure most obviously correct, beyond all need of checking, is the mistake.

Prepared daily by the employees of Schneider's Information / Public Affairs Department. Items to be included should be sent to Jennifer Wendell, Editor --- extension 5617, MS 100.